REMARKS

Claim 8 has been rewritten in independent form as claim 11.

Claim 9 has been rewritten in independent form as claim 12.

Paragraph 3 of the Office Letter

On the comments regarding Claim 8 being unpatentable over Aviram et al. (U.S. 4,491,431) in view of Jankowski et al. (U.S. 6,217,722) and Kaiser (U.S. 4,591,417):

(a) Aviram et al state that thin film resistors can be formed by utilizing suitable mixtures of a metal and wide band gap dielectric but they do not state what the thermal coefficient of resistance (TCR) of their films is nor do they teach how to obtain a near-zero TCR by varying the power and pressure of the sputtering gas.

(b) Aviram et al state that one can vary the ratio between a metal and its respective oxide by introducing a reactive gas during the evaporation or sputtering process (reactive evaporation or sputtering, respectively). However, they do not teach how to control this ratio accurately to achieve a specific resistivity or TCR that is near zero. In such reactive processes control cannot be achieved by simply varying a parameter such as evaporation or sputtering rate or that matter reactive gas partial pressure but rather the final outcome is very much dependent on the affinity of the given metal to the reactive gas and the number of gas phase reactions (on the target or evaporation source, the gas, and the substrate surface) and to a lesser degree on the relative gas pressure or evaporation rate. Since this is a very difficult control problem, even those skilled in the art will be unable to accurately control the respective metal/insulator ratios in order to obtain the desired resistivity and TCR, the TCR being more difficult to achieve than the resistivity.

In contrast, the present invention describes how the use of a magnetron, a composite target source with a given metal/dielectric composition, and accurate control of the sputtering pressure and r.f. power can lead to an accurate control of the resistivity and TCR.

(c) Jankowski et al teach rf sputter depositing from a ceramic target using a reactive mixture of Ar and O_2 to achieve a resistivity trend but they do not teach a method to achieve controllable and predictable values of a given resistance (see of instance Fig. 2). The reason the film resistance changes so much for a given Cr content is because the amount of oxygen reacted in the film is predicated by the Cr-O affinity rather than the partial pressure of the oxygen in the sputtering gas. Furthermore, for such large variations of resistance the TCR of the films will also change very much, thus not allowing control of the film TCR.

(d) The method employed by Kaiser et al requires very accurate control of the individual layers to achieve a given composition. It requires extremely thin layers (on the order of atomic dimensions) in order to have a homogeneous material. Deposition from a composite target described in the present invention is quite different as such control is not required. Furthermore, it is not clear what TCRs Kaiser can achieve in his method, thus one skilled in the art will not be able to achieve near zero TCR resistors described in the present invention.

Paragraph 4 of the Office Letter

On the comments regarding Claim 9 being unpatentable over Aviram et al. (U.S. 4,491,431) in view of Jankowski et al. (U.S. 6,217,722) and Kaiser et al (U.S. 4,591,417) and further in view of Hohenstein:

(a) Hohenstein describes a method of forming a thin film resistor that can possibly have a TCR as low as -400 ppm but with values of resistivity (specific resistance) that vary by orders of magnitude. Since his deposition method requires independent control of the deposition of a metal using DC and a ceramic using RF and furthermore of the degree the metal target is shadowed or not, it suggests that control of the resistivity and TCR of the film using his technique is a function of many parameters and thus too complicated for many. The present invention uses only one deposition approach (RF) and does not require independent control of the deposition of the metal and the ceramic component while assuring a given resistivity and TCR.

(b) Hohenstein states that the TCR of the low resistance films can be as low as -400 ppm, whereas in the present invention is able achieve near zero TCRs for a variety of films that span a range of resistance values, due to the fact that there is accurate control of the microstructure of the growing film.

(c) Hohenstein describes films that have been composed of Al, Ni or Cu as the metal and Pyrex as the dielectric component. The present invention teaches films that are made of Ta or W as the metallic component and SiO_2 as the dielectric.

On the comments regarding Claim 10 being unpatentable over Aviram et al. (U.S. 4,491,431) in view of Jankowski et al. (U.S. 6,217,722) and Kaiser et al (U.S. 4,591,417) and further in view of Swinehart et al (U.S. 5,367,285):

(b) Swinehart et al teach how to form a cermet film using a metal target being sputtered in the presence of a reactive gas (mixtures of oxygen and nitrogen). This approach is sufficiently different from the present invention as mentioned earlier.

(b) Although Swinehart et al teach that one skilled in the art could deposit these films on an oxidized silicon substrate they admit that such films, if deposited at substrate temperatures below 250°C have a tendency to peel from the substrate, have high porosity and are imperfect (Col. 5, lines 27-31). The present invention teaches how to deposit films at nominally room temperature with good stability, reliability, and having a desirable resistivity and TCR.

In view of the preceding, it is believed that claims 10, 11, and 12 clearly define patentable subject matter within the meaning of 35 U.S.C. 103, which Notice if respectfully requested.

Applicant respectfully requests reconsideration is the previously filed Petition for Revival of an Application for Patent Abandoned Unintentionally (copy enclosed).

Respectfully submitted,

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